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WESTMAN CHAMPLIN (MICROSOFT CORPORATION)
SUITE 1400
900 SECOND AVENUE SOUTH
MINNEAPOLIS, MN 55402-3319

EXAMINER	
GODBOLD, DOUGLAS	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/724,008	LIU ET AL.	
	Examiner	Art Unit	
	Douglas C. Godbold	2626	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 30 November 2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1,2,5,6,9,11-15,17,18,23,24 and 29 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,2,5,6,9,11-15,17,18,23,24 and 29 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 20071130.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to correspondence filed November 30, 2007 with respect to application 10/724,008. Claims 1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24, and 29 are pending in the application and have been examined.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 30, 2007 has been entered.

Response to Amendment

3. The amendments filed November 30, 2007 have been considered and accepted in this office action. Claims 1, 9, 12, and 14 have been amended, and claims 7, 8, 10, and 30 have been cancelled.

Response to Arguments

4. Applicant's arguments with respect to claims 1, 2, 5, 6, 9, and 11 have been considered but are moot in view of the new ground(s) of rejection.

5. Applicant's arguments filed November 30, 2007, with respect to claims 12 and 14 have been fully considered but they are not persuasive.

6. With respect to claim 12, see page 11 of remarks, that the art does not show choosing a frequency from a group of frequencies, the examiner respectfully disagrees. Park teaches identifying the frequency, from a group of frequencies. The claim language does not define a group of frequencies. Therefore the group of frequencies can in fact be interpreted as a group of all frequencies. Therefore this is equivalent to determining the pitch of the signal.

7. With respect to applicants arguments, see page 12 of remarks, that Griffin does not teach forming a clean value and does not use a weighted sum, the examiner respectfully disagrees. Griffin was used merely to show that sinusoid frequency information can be combined with residual information in order to produce a signal estimate. Therefor the applicants assertion that the Griffin does not teach producing a clean signal is moot. The applicant further argues that Griffin does not use a weighted sum, the examiner respectfully disagrees. Griffin discusses that the residual components are determined by a weighted overlap and add. Therefore the result is the residual component is weighted in the addition to the frequency components; see Griffin, column 13 line 62 - column 14 line 7.

8. With respect to applicants arguments, see remarks page 13, that the prior art does not teach or suggest the newly added limitation the weighted sum is computed using the covariance of the noise model to compute weights for the weighted sum, the examiner respectfully disagrees. Frey is used to teach noise models using Gaussian distributions. As Frey is composed of multiple distributions, see paragraphs 0062 and 0063, there will be covariance between the distributions. It would be obvious to consider the covariance when weighting as the covariances indicate how correlated the noise signals are, indicating the depth of the noise that is being filtered out.

Claim Rejections - 35 USC § 103

9. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

10. Claims 1, 2, 5, 9 and 11 rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA) in view of Frey et al (US PAP 2002/0173953.) and in further view of Zangi et al (US PAP 2004/0111258).

11. Consider claim 1, the APA teaches a method of determining an estimate for a noise-reduced value representing a portion of a noise-reduced speech signal (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 line 25.), the method comprising:

generating an alternative sensor signal using an alternative sensor other than an air conduction microphone (This system is trained using three training channels: a noisy alternative sensor training signal… Specification page 2, line 28-30.);

converting the alternative sensor signal into at least one alternative sensor vector (Each of the digitized signal frames are converted into a feature domain; Specification page 3, line 2.); but does not specifically teach:

adding a plurality of correction vector to the alternative sensor vector to form the estimate for the noise-reduced value: wherein each correction vector corresponds to a mixture component and each weight to a correction vector is based on the probability of the correction vector's mixture component, given the alternative sensor vector.

But the APA does not teach combining a correction vector to the alternative sensor vector to form the estimate for the noise-reduced value

However the APA does suggest combining a correction vector to the alternative sensor vector to form the estimate for the noise-reduced value (Once trained, the mappings are applied to a noisy vector formed from a combination of a noisy alternative sensor test signal and a noisy air conduction microphone test signal. This mapping produces a clean signal vector; Specification page 3, lines 10-14. Spectral subtraction [or adding a negative] of the noise vector from noisy signal vector would have been the obvious way to do this to one of ordinary skill in the art at the time of the invention. The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors

are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, line 3.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use spectral subtraction as a way of reducing the noise in a signal vector as a way to implement the noise reduction method of the APA, as this technique is well known in the art, eliminating the need for one to develop this part of the software on their own, reducing development costs.

But the APA does not teach specifically teach or suggest that the vectors are weighted, nor that when they are combined, they are added together and wherein each correction vector corresponds to a mixture component and each weight to a correction vector is based on the probability of the correction vector's mixture component, given the alternative sensor vector, that the noise reduced value is determined in the cepstral domain and converting the estimate back to the power spectrum domain.

In the same field of noise reduction, Frey suggests weighting noise feature (figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. This could obviously be used as a weighting to when processing the signals further down.), that the noise reduced value is determined in the cepstral domain (paragraphs 0063, and 0064 noise models are assembled using cepstral components.) and converting the estimate back to the power spectrum domain (it would be obvious that the signal would have o be converted back to the spectrum domain in order for it to be used to represent the signal in a meaningful way, as cepstral analysis is a log scale.)

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probability weightings that are suggested by Frey with the noise filtering scheme as taught by the APA in order to provide a method of filtering noise out of a signal that takes into consideration the probability that the signal component is in fact noise.

But this combination of the APA and Frey does not teach adding a plurality of signal vectors together and wherein each correction vector corresponds to a mixture component and each weight to a correction vector is based on the probability of the correction vector's mixture component, given the alternative sensor vector.

generating an air conduction microphone signal;

converting the air conduction microphone signal into an air conduction vector;

estimating a noise value;

subtracting the noise value from the air conduction vector to form an air conduction estimate;

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value in the power spectrum domain.

In the same field of noise reduction, Zangi teaches adding a plurality of signal vectors together (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090.).

generating an air conduction microphone signal (using microphone 26a);

converting the air conduction microphone signal into an air conduction vector (digital frames input to R[I] into signal processor 52);

estimating a noise value (The AP 72 includes the one or more AP filters 74a-74M; adaptive filters imply that an estimate a noise value is calculated. Zangi's adaptive filters operate by estimating a noise spectrum from a noisy signal spectrum and subtracting it from the noisy signal spectrum to produce a "clean" signal. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.);

subtracting the noise value from the air conduction vector to form an air conduction estimate (The AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters subtract a noise estimate from the noisy signal in order to estimate the signal);

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value in the power spectrum domain (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. The first processor filters are adapted in accordance with a noise power spectrum at the microphones and the second processor filter is adapted in accordance with a power spectrum of the intermediate output signal; paragraph 0019. Zangi's adaptive filters operates by estimating a noise spectrum from a noisy signal, spectrum and removing it from the noisy signal spectrum to produce a "clean" signal spectrum, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the addition of vectors as taught by Zangi with the noise reduction of APA and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

In view of this Combination, Frey now suggests wherein each correction vector corresponds to a mixture component and each weight applied to a correction vector is based on the probability of the correction vector's mixture component given the alternative sensor vector (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each signal component could obviously be represented by a vector when being combined in the system of the combination above.).

12. Consider claim 2, the APA teaches the method of daim 1 wherein generating an alternative sensor signal comprises using a bone conduction microphone to generate the alternative sensor signal (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

13. Consider claim 5, the APA teaches the method of daim 1 further comprising training a correction vector through steps comprising:

generating an alternative sensor training signal (This system is trained using three training channels: a noisy alternative sensor training signal... Specification page 2, lines 28-30.);

converting the alternative sensor training signal into an alternative sensor training vector (Each of the digital signals frames are converted into a feature domain; Specification page 3, lines 2-3.);

generating a clean air conduction microphone training signal (This system is trained using three training channels: a noisy alternative sensor training signal... and a clean air conduction signal; Specification page 2, line 28 – page 3 line 2.);

converting the clean air conduction microphone training signal into an air conduction training vector (Each of the digital signals frames are converted into a feature domain; Specification page 3, lines 2-3.); and

using the difference between the alternative sensor training vector and the air conduction training vector to form the correction vector (The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, lines 3-7).

14. Consider claim 6, the APA teaches the method of daim 5 wherein training a correction vector further comprises training a separate correction vector for each of a

plurality of mixture components (The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, lines 3-5. This suggests each noisy vector is mapped to the clean vector in this step to determine the noise in each separate channel).

15. Consider claim 9, Zangi teaches the method of claim 1 further comprising using the refined estimate for the noise-reduced value to form a filter (Figure 5, the same filters are used as in figure 4, but the combined output is provided to adaptation processor 54 which intern updates the filters of processor 72.; paragraph 0094-0131).

16. Consider claim 11, the APA, Frey and Zangi teaches the method of claim 1, The APA teaches further comprising:

generating a second alternative sensor signal using a second alternative sensor other than an air conduction microphone (APA, This system is trained using three training channels: a noisy alternative sensor training signal... Specification page 2, line 28.);

converting the second alternative sensor signal into at least one second alternative sensor vector (APA, Each of the signals is converted into a feature domain; Specification page 3, line 2.); and

adding a correction vector to the second alternative sensor vector to form a estimate for the noise-reduced value (APA, Once trained, the mappings are applied to a noisy vector formed from a combination of a noisy alternative sensor test signal and a noisy air conduction microphone test signal. This mapping produces a clean signal vector; Specification page 3, line 10.).

The APA and Frey do not teach

using multiple sensors, signals, and clean signal estimation, and combining a second corrected estimate with another corrected signal estimate.

In the same field of noise reduction, Zangi teaches using multiple sensors, signals, and clean signal estimation (Zangi, figure 4, microphones 26a-26m, filters 74a-74m and signals associated with), and combining a second corrected estimate with another corrected signal estimate (Zangi, the outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate.).

Therefore it would have been obvious to one of ordinary skill in the art to ally the multiple sensors and using a second estimate as taught by Zangi with the noise reduction of the APA and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

17. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al (US Patent 5,590,241) in view of the APA further in view of Griffin et al (US Patent 5,701,390).

18. Consider claim 12, Park teaches a method of determining an estimate of a clean speech value (using figure 1), the method comprising:

receiving an alternative sensor signal from a sensor other than an air conduction microphone (output of accelerometer 34.);

receiving a noisy air conduction microphone signal from an air conduction microphone (output of microphone 31.);

identifying a which frequency of a group of candidate frequencies is a pitch frequency for a speech signal based on the alternative sensor signal (accelerometer 34 produces a signal which has primarily low-frequency speech components; column 3, line 21.); but does not teach specifically:

using the pitch frequency to decompose the noisy air conduction microphone signal into a harmonic component and a residual component by modeling the harmonic component as a sum of sinusoids that are harmonically related to the pitch; and

using the harmonic component and the residual component to estimate the clean speech value speech value by determining the weighted sum of the harmonic component and the residual component, the clean speech value representing a noise-reduced signal having reduced noise relative to the noisy air conduction microphone signal.

In the same field of noise reduction the APA teaches using the pitch to decompose the air conduction microphone signal into a harmonic component and a residual component and using the harmonic component and the residual component to

estimate the clean speech value (One system or the prior art for estimating the noise in a speech signal uses the harmonics of human speech. The harmonics of human speech produce peaks in the frequency spectrum. By identifying nulls between these peaks, these systems identify the spectrum of the noise. This spectrum is then subtracted from the spectrum of the noisy speech signal to provide a clean speech signal; Specification, page 2, lines 3-10.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the harmonic separation scheme in conjunction with the signal cleaning method of Park, as the accelerometer would in fact provide a great estimation of the harmonics of the voiced speech.

However this combination does not specifically teach modeling the harmonic component as a sum of sinusoids that are harmonically related to the pitch and determining the weighted sum of the harmonic component and the residual component the clean speech value representing a noise- reduced signal having reduced noise relative to the noisy air conduction microphone signal.

In the same field of speech recognition, Griffin teaches modeling the harmonic component as a sum of sinusoids that are harmonically related to the pitch (the voice speech components are determined at least in part using a bank of sinusoidal oscillators, with the oscillator characteristics being determined from the fundamental frequency and regenerated spectral phase information; column 5, line 7.) and determining the weighted sum of the harmonic component and the residual component (figure 2 shows the voiced synthesis and unvoiced synthesis components are added to

produce an estimated speech signal. It is inherent that these will be weighted according to the amplitudes that were inputted into the encoding end.).

Therefore it would have been obvious to one of ordinary skill in the art to combine the estimation techniques of Griffin with the system of Park and the APA in order to provide a well known method of modeling the voiced and residual parts of a signal.

This combination now suggests that the clean speech value representing a noise- reduced signal having reduced noise relative to the noisy air conduction microphone signal, as Griffin is combining the pitch information from the bone sensor as taught by the APA and Park in order to develop a clean signal estimate.

19. Consider claim 13, Park in view of the embodiment of the APA used in claim 12 teaches the method of claim 12 but does not specifically teach wherein receiving an alternative sensor signal comprises receiving an alternative sensor signal from a bone conduction microphone.

In the same field of noise reduction, a different embodiment of the APA teaches receiving an alternative sensor signal from a bone conduction microphone (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a bone conduction microphone as taught by the APA in lieu of

the accelerometer as taught by Park, as the resulting signal would be substantially similar in nature.

20. Claims 14, 17, 18, 23, 24 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Zangi and further in view of Frey.

21. Consider claim 14, Park teaches a computer-readable storage medium storing computer- executable instructions (figure 1, implemented on computer readable medium; column 8 line 25,) for performing steps comprising:

receiving an alternative sensor signal from an alternative sensor that is not an air conduction microphone (figure 1, output of accelerometer 34);

receiving a noisy test signal from an air conductive microphone (Figure 1 shows a microphone 31 that picks up both noise 22 and voice 31. The noisy test signal is then added 38 to the output of the adaptive filter 37 [fed by the accelerometer 34], the sum being used to adjust the adaptive filter 37; Abstract.).

generating a noise estimate from the noisy test signal (Summing device 38 has a positive input terminal for receiving MICROPHONE INPUT SIGNAL, a negative input terminal for receiving the ENHANCED SPEECH SIGNAL, and an output terminal for providing a signal labeled "ESTIMATION ERROR" to the error input of adaptive filter 37; column 3, line 50. The estimation error is in fact a noise estimate.)

converting the noisy test signal (from 31) into at least one noisy test vector (output of microphone 31 fed to ADC 33, covering signal to a vector of digital samples.)

forming an alternative sensor vector from the alternative sensor signal (Park, ADC 36 converts the analog signal into a vector of time samples);

adding a correction vector to the alternative sensor vector to form an alternative sensor estimate of the clean speech value (Park, adaptive filter 37 filters the signal to produce a clean estimate. Filtering a signal is analogous to adding a corrective vector to it.)

but does not specifically teach:

subtracting a mean of the noise model from the noisy test vector to form a difference; and

setting a weighted sum of the difference and the alternative sensor estimate to form the estimate of the clean speech value estimate,

wherein the weighted sum is computed using the covariance of the noise model to compute weights for the weighted sum.

In the same field of noise reduction, Zangi teaches subtracting a mean of the noise model from the noisy test vector to form a difference (Figure 4, the AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters operate by estimating a noise spectrum, which will be an average or mean of the noise signal by the very nature of adaptive filters, from a noisy signal and removing it from the noisy signal to produce a "clean" signal, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.); and

setting a weighted sum of the difference and the alternative sensor estimate to form the estimate of the clean speech value estimate (Zangi, he outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. Although Zangi doesn't teach mixing the estimate from an alternative transducer, one of ordinary skill in the art could appreciate that if the information was available it would be obvious to use it in combination with the other estimated clean values, as this input device of this algorithm has little to do with its effectiveness. Combining more estimates from any kind of transducer would improve the final resultant estimate).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the filtering method of Park with the signal from the air transducer microphones as taught by Zangi in order to provide a robust method of cleaning a signal from a standard microphone.

But the combination Park and Zangi does not explicitly teach that the noise estimation is a noise model comprised of a mean and a variance.

In the same field of noise reduction, Frey teaches using a noise model comprising a mean and a variance (Paragraph 0054 discusses using Gaussian distributions to model channel noise in a system. Gaussian distributions have a mean and a variance by definition.)

wherein the weighted sum is computed using the covariance of the noise model to compute weights for the weighted sum (Frey is used to teach noise models using Gaussian distributions. As Frey is composed of multiple distributions, see paragraphs

0062 and 0063, there will be covariance between the distributions. It would be obvious to consider the covariance when weighting as the covariances indicate how correlated the noise signals are, indicating the depth of the noise that is being filtered out.)

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use mean and variance as suggested by Frey to model noise in the system of Park and Zangi in order to provide a well known effective method to model noise in a signal.

22. Consider claim 17, Park teaches the computer-readable medium of claim 16 but does not specifically teach wherein adding a correction vector comprises adding a weighted sum of a plurality of correction vectors, each correction vector being associated with a separate mixture component.

In the same field of noise reduction, Frey teaches using probability to assign a score to determine if a signal is noise or not. (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each signal component could obviously be represented by a vector.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probabilities that are taught by Frey with the noise filtering scheme as taught by the APA in order to provide a method of filtering noise out

of a signal, based on the probability that a signal is a noise, in order to avoid a desired content of a signal from being filtered out.

But this combination of the Park, and Frey does not teach adding a plurality of signal vectors together.

In the same field of noise reduction, Zangi teaches adding a plurality of signal vectors together (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the addition of vectors as taught by Zangi with the noise reduction of Park and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

23. Consider claim 18, Frey teaches the computer-readable medium of claim 17 wherein adding a weighted sum of a plurality of correction vectors comprises using a weight that is based on the probability of a mixture component given the alternative sensor vector. (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each digital signal frame component is represented by a vector.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probabilities that are taught by Frey with the noise filtering scheme as taught by Park in order to provide a method of filtering noise out of a

signals by determining the probability that it is in fact noise, thereby reducing the chance that the "clean" part of the signal is accidentally filtered out as well.

24. Consider claim 23, Park teaches the computer-readable medium of claim 22 but does not specifically teach wherein the estimate of the clean speech value is in the power spectrum domain.

In the same field of noise reduction, Zangi teaches the estimate of the clean speech value is in the power spectrum domain (The first processor filters are adapted in accordance with a noise power spectrum at the microphones and the second processor filter is adapted in accordance with a power spectrum of the intermediate output signal; paragraph 0019. Zangi's adaptive filter operates by estimating a noise spectrum from a noisy signal spectrum and removing it from the noisy signal spectrum to produce a "clean" signal spectrum, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.).

Therefore it would have been obvious to one of ordinary skill in the art at time tome of the invention to combine using the power spectrum domain as taught by Zangi with the system of Park in order to provide a standard and well known way of filtering a signal.

25. Consider claim 24, Park teaches the computer-readable medium of claim 23 but does not specifically teach further comprising using the estimate of the clean speech value to form a filter.

26. In the same field of noise reduction, Zangi teaches using the estimate of the clean speech value to form a filter (Figure 5, the same filters are used as in figure 4, but the combined output is provided to adaptation processor 54 which intern updates the filters of processor 72; paragraphs 0094-0131).

Therefore it would have been obvious to one of ordinary skill in the art at time tome of the invention to combine forming a filter with the clean speech value as taught by Zangi with the system of Park in order to provide an easy and intuitive way to generate a cleaned signal form a noisy signal.

27. Consider claim 29 Park teaches the computer-readable medium of claim 14 further comprising:

receiving a alternative sensor signal from a alternative sensor that is not an air conduction microphone (figure 1, output of accelerometer 34); but does not specifically teach a second alternative sensor signal and sensor nor using the second alternative sensor signal with the first alternative sensor signal to estimate the clean speech value.

Park does not specifically teach using multiple sensors, and using the second alternative sensor signal with the alternative sensor signal to estimate the clean speech value.

In the same field of noise reduction, Zangi teaches using multiple sensors (figure 4, microphones 26a-26m, filters 74a-74m and signals associated with), and using the second alternative sensor signal with the alternative sensor signal to estimate the clean

speech value (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. Although Zangi doesn't teach alternative sensors, one of ordinary skill in the art can appreciate that the same algorithm can be applied to alternative sensors.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the multiple clean signal estimates as taught by Zangi with the noise reduction system of Park in order to provide a method to dynamically change the adapting signals in order to improve the signal to noise ratio (abstract Zangi). It is also clear that the input to the algorithm of Zangi would have little effect on its effectiveness. Combining more estimates from any transducers would improve the final resultant estimate.

28. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Zangi as applied to claim 14 above, and further in view of the APA.

29. Consider claim 15, Park teaches the computer-readable medium of claim 14 but does not teach specifically wherein receiving an alternative sensor signal comprises receiving a sensor signal from a bone conduction microphone.

In the same field of noise reduction, the APA teaches receiving an alternative sensor signal from a bone conduction microphone (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative

sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a bone conduction microphone as taught by the APA in lieu of the accelerometer as taught by Park, as the resulting signal would be substantially similar in nature.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas C. Godbold whose telephone number is (571) 270-1451. The examiner can normally be reached on Monday-Thursday 7:00am-4:30pm Friday 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Edouard can be reached on (571) 272-7603. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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DCG

TĀLIVALDIS IVARS ŠMITS
PRIMARY EXAMINER